

(12) UK Patent Application (19) GB (11) 2 235 032 (13) A

(43) Date of A publication 20.02.1991

(21) Application No 8918363.6

(22) Date of filing 11.08.1989

(71) Applicant
Ford Motor Company Limited
 (Incorporated in the United Kingdom)

**Eagle Way, Brentwood, Essex, CM13 3BW,
 United Kingdom**

(72) Inventor
Roy James Murchie

(74) Agent and/or Address for Service
A Messulam & Co
**24 Broadway, Leigh-on-Sea, Essex, SS9 1BN,
 United Kingdom**

(51) INT CL⁵
F16F 7/12

(52) UK CL (Edition K)
F2S SCM
U1S S1820 S1858

(56) Documents cited
GB 2020743 A GB 1397757 A GB 1358370 A
GB 0932027 A US 4073482 A

(58) Field of search
UK CL (Edition J) B7B BSEB, F2S SCM
INT CL⁴ B60R, F16F
W.P.I.

(54) Energy absorbing structure

(57) The broad end of a conical fibre reinforced plastics structure 18 is positioned so as to receive an impact load, with the narrow end being secured to a relatively fixed structure 16, and the wall of the conical structure being constructed so that the broad end of the structure collapses first and the rest of the structure progressively collapses towards the narrow end.

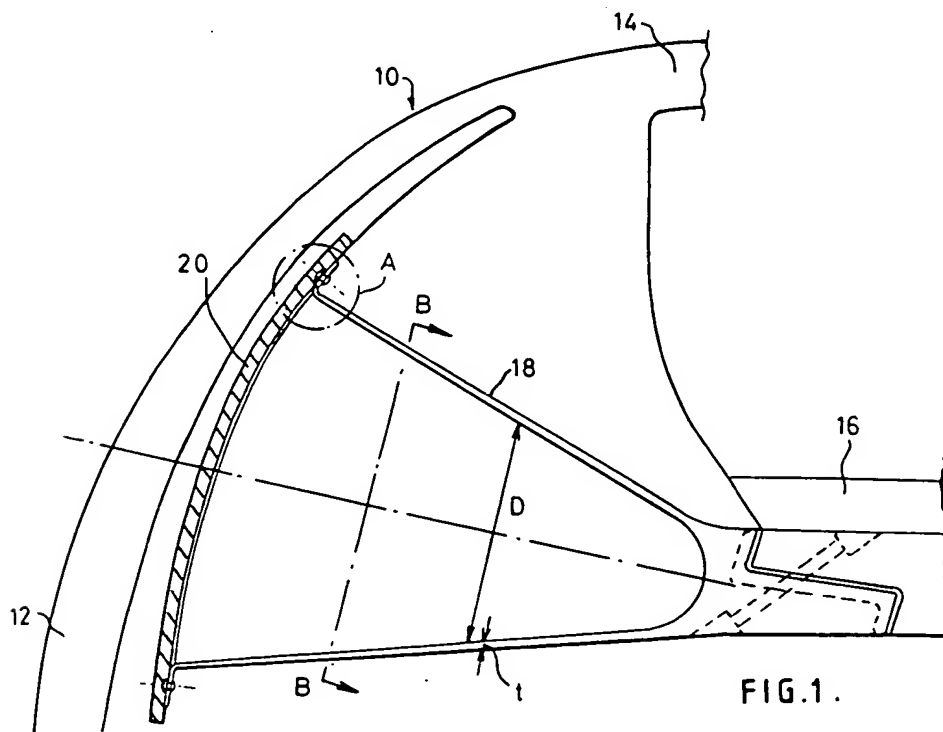


FIG.1.

ENERGY ABSORBING STRUCTURE

vention relates to an energy absorbing structure may have a wide variety of applications but finds a similar application in the automotive field, particularly in the mounting of bumpers on vehicles.

proposals have been made for providing the basrs of motor vehicles with some energy absorbing capability, including filling the bumpers with a material and the mounting of collapsible structures between the bumper structure itself and the body structure. Such arrangements provide a low level of energy absorption (but sufficient to pass statutory low speed tests) but there is still a desire to provide a much greater degree of energy absorption in this area.

It is also known that a hollow conical structure is a very efficient shape for progressively absorbing energy. As the amount of energy absorption increases, crushing takes place as a result of the continually increasing cross sectional area of the cone presented to the impact. As crushing continues, but also a large base of the cone ensures that the desired crushing resistance is obtained over a range of impact velocities. This is described in "Crash energy absorption of fibre-reinforced plastics in vehicle collisions" by Hans Vogt, Peter Beardmore and Derek Jones presented at the Mannheim Conference of the German fibre reinforced plastics society.

According to the known proposals, however, the broad base of the cone is supported on a fixed structure, and the impact load or energy to be absorbed is received at the narrow end. This configuration is unsuitable for use particularly on the front bumper of a motor vehicle,

there is insufficient space at the front of the compartment to package the broad base of the

ing to the present invention, there is provided an absorbing structure arranged between a potential position and a support position, wherein the structure occupies a generally conical volume with the larger end of the cone presented to the potential impact position and the smaller end at the support position, the structure being constructed so that, working from the larger end towards the smaller end, the amount of energy absorbed by destruction of the cone progressively increases.

Placing the cone in an inverted position means that using the structure as an energy absorption device for a vehicle bumper becomes possible because sufficient space may be found for the small end of the structure inboard of the end of the vehicle, for example in the engine compartment or within or below the luggage compartment.

Gradually increasing energy absorption towards the larger end of the cone can be achieved by increasing the thickness of the cone towards the apex.

Other strategies for increasing the energy absorption can be considered; for example increasing the material density in the structure or changing the configuration locally.

A rigid end plate can be provided at the larger end of the cone so that the destruction of the structure takes place against the plate. For example, the structure can be secured to the inner face of a bumper reinforcement.

arger end of the cone is preferably associated with
gering formation to initiate destruction. The
ring formation could be a chamfer on the end of
e.

ng to a second aspect of the invention, there is
ed a bumper mounting arrangement in a motor
e, wherein a bumper of the motor vehicle is
to the larger end of a generally conical energy
ng structure, the smaller end of the structure is
connected to a vehicle frame member, and the
axis of the structure is directed generally
s from the mounting point.

m "generally forwards" includes arrangements
he cone axis is intentionally offset towards the
on of the expected force. The offset could for
be outwards and/or upwards.

ller end of the structure can be constructed so
locates and engages with a frame member,
ly one of the side rails of the vehicle.

ucture is preferably formed by a moulding
, and the fastenings by which the structure is
to the vehicle and to the bumper can be moulded
e structure.

angement may be provided at the front and/or at
k of the vehicle.

ention will now be further described, by way of
, with reference to the accompanying drawing in

1 is a plan view , partly in section, of a motor
bumper arrangement in accordance with the
on;

2 is a section on the line B-B from Figure 1; and

3 is a detail view within the circle A from 1.

1 shows a bumper bar 10 with a front region 12 rap-around side region 14. The motor vehicle has a side rail 16, only the front edge of which n. Clearly there will be a corresponding side the opposite side of the vehicle but this is not n the Figure.

per bar 10 is connected to the side rail 16 by an absorbing structure 18. This energy absorbing re is generally hollow and conical and will be cted of a reinforced plastics material. An end r mandrel 20 is fitted on the inside of the bar to provide a surface against which the re 18 can be crushed.

ignificant that the broader end of the cone is forwards, secured to the bumper bar. The energy ion characteristics are of fundamental nce, and it is desired that the front end (ie the nd) of the cone be the first to be destroyed when is absorbed. A specific ramp up of energy ion is required. The desired increasing energy ion characteristic along the cone axis requires l consideration of the local wall thickness (t), thickness: diameter ratio (t/D) and the local lius (r). These parameters can be traded off to the desired absorption characteristics.

usually be necessary to provide a triggering at the larger end of the cone to ensure that of the cone commences at the desired position. ple triggering feature is a chamfer as shown at .gure 3. However other alternative triggering

as are known in the art and could be used here.

ss section of the cone may be regular but need so. Figure 2 shows by way of example a flattened section, and here the inclusion of flat areas, have little energy absorbing ability, provides means of tuning the energy absorption characteristics as desired.

ical structure 18 could be manufactured by resin, r moulding, filament winding, compression g of thermosetting plastics, compression moulding moplastic plastics, or injection moulding of einforced plastics which may be either etting or thermoplastic.

h the invention has been described here in ion with a bumper bar support, other applications e found wherever energy has to be absorbed, and he force could arrive from within a given cone

A possible example of another application is in vehicle steering column assembly where the end of the cone would be directed towards the

ention provides the advantages of tunable energy ion characteristics, in the particular tion described, packaging advantages in that the nd of the cone is packaged near the engine where s at a premium, and the broad end is packaged at per end where there is available space.

CLAIMS

An energy absorbing structure arranged between initial impact position and a support position, wherein the structure occupies a generally conical shape with the larger end of the cone presented to the initial impact position and the smaller end at the support position, the cone being constructed so that, from the larger end towards the smaller end, the amount of energy absorbed by destruction of the cone progressively increases.

An energy absorbing structure as claimed in claim 1, wherein the gradually increasing energy absorption towards the smaller end of the cone is achieved by increasing the wall thickness of the cone towards the apex.

An energy absorbing structure as claimed in claim 1, wherein the gradually increasing energy absorption is achieved by increasing the wall thickness:diameter ratio of the cone towards the apex.

An energy absorbing structure as claimed in claim 1, wherein the gradually increasing energy absorption is achieved by modifying the cross sectional area of the cone towards the apex.

An energy absorbing structure as claimed in claim 1, wherein an end plate is mounted at the larger end of the cone.

An energy absorbing structure as claimed in claim 1, wherein a triggering formation is provided at the larger end of the cone.

7. A bumper mounting arrangement in a motor vehicle, wherein a bumper of the motor vehicle is secured to the larger end of a generally conical energy absorbing structure, the smaller end of the structure is rigidly connected to a vehicle frame member, and the conical axis of the structure is directed from the mounting point towards the direction of the expected impact.
8. An arrangement as claimed in Claim 7, wherein the smaller end of the structure is constructed so that it locates and engages with a frame member, typically one of the side rails of the vehicle.
9. An arrangement as claimed in Claim 7 or Claim 8, wherein the structure is formed by a moulding process, and the fastenings by which the structure is secured to the vehicle and to the bumper are moulded into the structure.
10. A bumper mounting arrangement in a motor vehicle, substantially as herein described with reference to the accompanying drawing.

